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The Trichoptera of Panama. XVII. One new genus record and twelve first species records of microcaddisflies (Trichoptera, Hydroptilidae) from the Republic of Panama

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Abstract

Herein we add first country records to Panama's microcaddisfly fauna (Trichoptera, Hydroptilidae), one genus—*Orthotrichia* Eaton, 1873—and 12 species—*Alisotrichia latipalpis* Flint, 1991; *Hydroptila constricta* Bueno-Soria, 1984; *Metrichia decora* Bueno-Soria & Holzenthal, 2003; *Metrichia malada* (Flint, 1991); *Neotrichia amplector* Keth, 2004; *Neotrichia armata* Botosaneanu, 1993; *Neotrichia kampa* Oláh & Johanson, 2011; *Ochrotrichia silva* Bueno-Soria & Holzenthal, 1998; *Orthotrichia aegerfasciella* (Chambers, 1873); *Rhyacopsyche hasta* Wasmund & Holzenthal, 2007; *Rhyacopsyche mexicana* (Flint, 1067); and *Zumatrichia strobilina* Flint, 1970. Panama now hosts 461 species of Trichoptera.

Keywords

Geographic distribution, hydroptilids, new country records

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Introduction

Beginning in 2014, field sampling commenced to increase our knowledge about the presence and distribution of Panama's adult caddisflies. Since then, we have added two families, 10 genera, and 203 species to Panama's fauna, nearly doubling what had been known before (Thomson and Armitage 2021). Whereas quite a number of the species added were new to science, the majority were first country records. In this paper, we record one genus and 12 species new to Panama, distributed throughout the country and derived from a number of projects. Among these new records are three species which were collected, but never reported, by past trichopterists, now deceased. Five other species were collected as part of a multi-year survey of Panama's national parks

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under the management of the Ministerio de Ambiente. Designated "Proyecto Sistema de Producción Sostenible Conservación de la Biodiversidad (PSPSCB; http://produccionsostenibleybiodiversidad.org/proyecto/)", this survey was funded by the World Bank. M'Ambiente collaborated with the Instituto Conmemorativo Gorgas de Estudios de la Salud (Gorgas Institute), and their Colección Zoológica Dr. Eustorgio Méndez (COZEM) to execute the work. Finally, four species were collected by several of the coauthors as part of a project registered by the Museo de Peces de Agua Dulce e Invertebrados (MUPADI) of the Universidad Autónoma de Chiriquí (UNACHI).

Methods

Single, overnight collections were made, in general, using UV light traps (Calor and Mariano 2012). Multiple-night collections were made employing Malaise traps over four or more 24-hour periods. Specimens were prepared and examined following standard methods outlined in Blahnik and Holzenthal (2004). Microcaddisfly specimens were soaked in 5% KOH overnight and washed in weakly acidified alcohol prior to examination under a dissecting scope. All specimens are stored in 75–80% ethanol.

Country distributions for the taxa added to Panama's fauna are presented in Figure 1A. Collection locations within Panama and associated taxa are indicated in Figure 1B. Specimens listed in this publication are deposited in MUPADI, COZEM, or NMNH (US National Museum of Natural History). Morphological terminology follows Marshall (1979), and the higher classification within the Hydroptilidae follows Holzenthal and Calor (2017). The order of genera below is alphabetic.

Results

First country records by map location (Fig. 1B) are listed in Table 1. The following text provides information about each genus from a Neotropical perspective, followed by collection, distribution, and identification information for each species recorded for Panama.

Genus *Alisotrichia* Flint, 1964

The genus *Alisotrichia* (Leucotrichiinae) is represented by 60 species. Restricted to the New World, its distribution ranges from the southwestern USA, south to Venezuela, and also in the Caribbean Sea's Antilles chain of islands (Holzenthal and Calor 2017). The seven species known from Panama include two new species recently described (Harris and Armitage 2019; Armitage and Harris 2020). Herein we add an eighth species.

Alisotrichia latipalpis Flint, 1991

New records (1 locality). PANAMA – Chiriqui Province • Cuenca 108; Boquete District; Finca Monterey; Quebrada Jaramillo; 08.7632°N, 082.4138°W; 1250 m a.s.l.; 20–25.iv.2018; K. Collier, leg.; Malaise trap; 1 male, MUPADI-SCH.2018.412 • ibid., 15–22.xi.2018; 5 males, MUPADI-SCH.2018.435.

Distribution. Colombia, Panama.

Identification. This species is in the *A. lobata* group (Harris and Holzenthal 1993; misspelled as "Lobatau" in table 1 of that paper), and is most closely related to *A. lobata* Flint, 1968 from Dominica. It differs from this latter species by the longer posterolateral process on sternum VIII, and by the differences in the structure of sternum IX.

Genus *Hydroptila* Dalman, 1819

Represented in the Neotropics by 72 species, the genus *Hydroptila* (Hydroptilinae) is worldwide in general distribution and can often occur in large numbers in light trap samples. Ten species are known from Panama, including seven which have been added recently (Armitage et al. 2015, 2016; Armitage and Harris 2018). Herein we add one additional species to Panama's fauna.

Hydroptila constricta Bueno-Soria, 1984

New records (2 localities). PANAMA – Chiriqui Province • Cuenca 108; Boquete District; Finca Monterey; Quebrada Jaramillo; 08.7632°N, 082.4138°W; 1250 m a.s.l.; 20–25.iv.2018; K. Collier, leg.; Malaise trap; 1 male, MUPADI-SCH.2018.409 • ibid., Baja Boquete; Valle Escondido; Quebrada Grande; 08.7797°N, 082.4402°W; 1122 m a.s.l.; 29.iv–2.v.2018; B. Armitage, T. Arefina-Armitage, leg.; Malaise trap; 1 male, MUPADI-SCH.2018.465.

Distribution. Belize, Colombia, Costa Rica, Honduras, Mexico, Panama, Peru.

Identification. This species was described from a specimen collected in Chiapas, Mexico and is most closely related to *H. arctia* Ross, 1938. It can be distinguished from this species by the long, narrow aedeagus with a recurved lateral process near the apex and by the distal widening of the inferior appendages in ventral view (Bueno-Soria 1984; Harris and Holzenthal 1999).

Genus *Metrichia* Ross, 1938

The genus *Metrichia* (Ochrotrichiinae) is represented by at least 143 species endemic to the New World and distributed in North, Central, and South America (Santos et al. 2016; Holzenthal and Calor 2017; Thomson and Armitage 2018; Harris and Armitage 2019; Armitage and Harris 2020). Previously, 31 species were recorded from Panama. Herein we add two new country records for Panama.

Metrichia decora Bueno-Soria & Holzenthal, 2003

New records (2 localities). PANAMA – Veraguas Province • Cuenca 097; Santa Fe National Park; afl. Río Calovebora; 08.5432°N, 081.1640°W; 536 m a.s.l.; 19–23.iv.2017; T. Ríos, E. Alvarez, C. Nieto, leg.; Malaise trap; PSPSCB PNSF-C097-2017-005; 4 males, 2-COZEM-SCH.2017.478, 2-MUPADI-SCH-2017.478 • ibid., Río

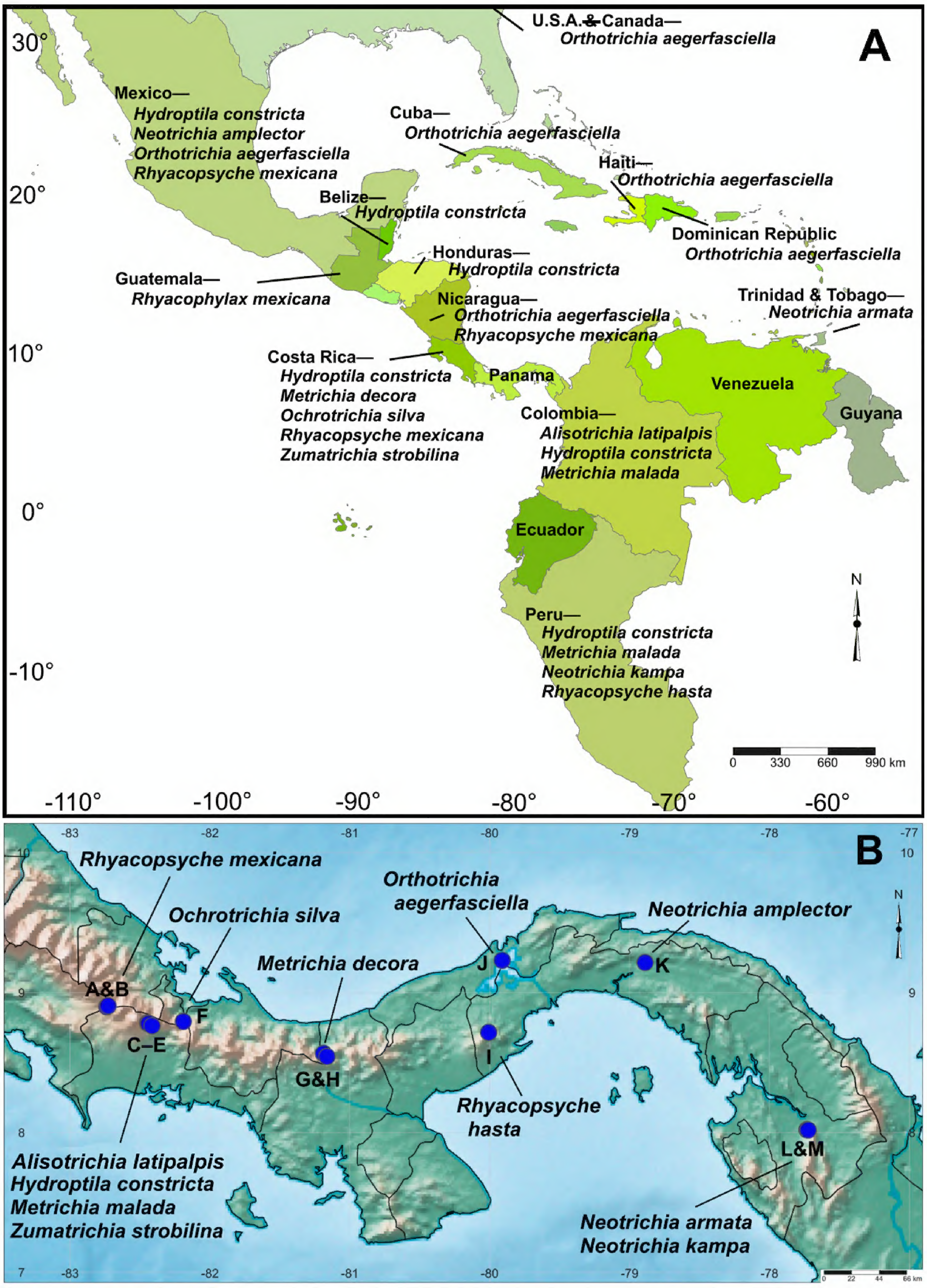

Figure 1. Maps. **A.** Regional map showing distribution of newly recorded Panamanian taxa in other countries. **B.** Map of Panama showing site locations and associated new country records. Please refer to Table 1 for additional information. Map A was created using ARCGIS 10.1 (ESRI corporation) software. Map B was created using Simplemappr software.

Table 1. Streams and new country records associated with map locations (please reference Figure 1B).

Map location	Watershed	New country records
A	Río Candela-Jurutungo	*Rhyacopsyche mexicana*
B	Río Candela-Finca Felix	*Rhyacopsyche mexicana*
C	afl. Quebrada Grande	*Metrichia malada*
D	Quebrada Grande	*Hydroptila constricta*
	"	*Metrichia malada*
	"	*Zumatrichia strobilina*
E	Quebrada Jaramillo	*Alisotrichia latipalpis*
	"	*Hydroptila constricta*
F	Quebrada Martinez	*Ochrotrichia silva*
G	Río Calevebora	*Metrichia decora*
H	Río Llanito	*Metrichia decora*
I	Río Chileno	*Rhyacopsyche hasta*
J	Canal Zone	*Orthotrichia aegerfasciella*
K	Río Cañita	*Neotrichia amplector*
L	Rio Tuira	*Neotrichia kampa*
M	Río Perresénico	*Neotrichia armata*

Llanito; 08.5655°N, 081.1882°W; 340 m a.s.l.; 20.iv.2017; UV light trap; PSPSCB PNSF-C097-2017-012; 1 male, COZEM-SCH-2017.482.

Distribution. Costa Rica, Panama.

Identification. This species was identified by employing the keys, descriptions, and figures by Bueno-Soria and Holzenthal (2003). It is a member of the *M. pencillata* group and is most closely related to *M. biungulata* Flint, 1972 with which it shares a small, tooth-like process on the posteroventral margin of the inferior appendage and two hook-like spines on the preapical region of the phallus (Bueno-Soria and Holzenthal 2003). It differs from this related species by the lack of a lateral spur on the phallus.

Metrichia malada (Flint, 1991)

New records (2 localities). PANAMA – Chiriqui Province • Cuenca 108; Baja Boquete, Valle Escondido; Quebrada Grande; 08.7837°N, 082.4443°W; 1125 m a.s.l.; 20.iv.2017; B. Armitage, T. Arefina-Armitage, leg.; UV light trap; 3 males, MUPADI-SCH.2017.433 • ibid., waterfall on afl. Quebrada Grande; 08.7829°N, 082.4458°W; 1253 m a.s.l.; 10.xi.2018; T. Arefina-Armitage, leg.; UV light trap; 1 male, MUPADI-SCH.2018.937.

Distribution. Colombia, Panama, Peru.

Identification. *Metrichia malada* was identified using the key, description, and figures provided by Flint (1991) and other reference material in hand. It most closely resembles *M. adamsae* (Flint & Bueno-Soria, 1998), which also has a small dark hook near the posterior margin of the inferior appendage. However, it differs from that species in having abdominal modifications and a more elongate segment IX.

Genus *Neotrichia* Morton, 1905

With a New World distribution, there are 156 species of the genus *Neotrichia* (Neotrichiinae) known from the Neotropics (Holzenthal and Calor 2017; Armitage and Harris 2018; Thomson and Armitage 2018; Harris and Armitage 2019; Armitage and Harris 2020). In Panama, 23 species are known, with 20 of them added since 2015, including 14 new species and six new country records. Herein we add three additional new country records to Panama's fauna.

Neotrichia amplector Keth, 2004

New record (1 locality). PANAMA – Panama Province • Cuenca 148; nr Cañita, afl. Río Cañita; 09.2156°N, 078.8897°W; 14 m a.s.l.; 24.ii.1985; O.S. Flint, Jr., J.A. Louton, leg.; UV light trap; 2 males, NMNH-SCH.2018.156.

Distribution. Mexico, Panama.

Identification. *Neotrichia amplector* is in the *N. collata* group and is most similar to *N. ersitis* Denning, 1948 (Keth 2004). Both species have short, triangular inferior appendages with robust serrations along the mesal margins and ornate sclerotized ridges at the apex of the subgenital plates. *Neotrichia amplector* differs from *N. ersitis* by having ventromesal folds of segment IX that embrace the subgenital plate and a lack of sclerotized, apical hooks on the apex of the phallus (Keth et al. 2015).

Neotrichia armata Botosaneanu, 1993 (in Botosaneanu and Alkins-Koo 1993)

New record (1 locality). PANAMA – Darien Province • Cuenca 156; Darien National Park; Río Perresénico ; Rancho Frio (Pirre 1); 08.0198°N, 077.7325°W, 125 m a.s.l., 9–12.ii.2018; A. Thurman, leg.; Malaise trap; 19 males, MUPADI-SCH.2018.213.

Distribution. Panama, Tobago, Trinidad.

Identification. This species was identified from keys, descriptions, and figures presented by Keth et al. (2015) and the original description. *Neotrichia armata* is in the *N. vibrans* group. This group's members are characterized by the following synapomorphic characters: sclerotized apicolateral extension of segment IX, and tapered margins of segment X. Unlike other members of this group, *N. armata* lacks the tapered inferior appendages, which in this species are quadrate, bearing stout spines from the distal margin.

Neotrichia kampa Oláh & Johanson, 2011

New record (1 locality). PANAMA – Darien Province • Cuenca 156; Darien National Park; near entrance; Río Tuira; 08.0175°N, 077.7242°W; 147 m a.s.l.; 16.ii.1985; J.A. Louton, leg.; UV light trap; 1 male, NMNH-SCH.2018-288.

Distribution. Panama, Peru.

Identification. This species was identified from keys, descriptions, and figures present in Oláh and Johanson (2011) and Keth et al. (2015). *Neotrichia kampa* is in the *N. collata* group and is most similar to *N. kampoka* Oláh & Johanson, 2011. It differs from this species by having the dorsum of segment IX undulating in lateral view; the posterodorsal processes of segment IX

stout, not slender; subgenital plate deeply divided ventrally into narrow, setal-tipped processes; and a terminal pair of phallic spines differently sized and shaped (Oláh and Johanson 2011).

Genus *Ochrotrichia* Mosely, 1934

The genus *Ochrotrichia* (Ochrotrichiinae) is represented by at least 170 species restricted to the New World and distributed in North, Central, and South America and the West Indies (Holzenthal and Calor 2017; Thomson and Armitage 2018; Harris and Armitage 2019; Thomson and Armitage 2021). Previously, 36 species were recorded from Panama. Herein we add one new country record.

Ochrotrichia silva Bueno-Soria & Holzenthal, 1998

New records (1 locality). PANAMA – Ngäbe Buglé Comarca • Cuenca 093; Bosque Protector Palo Seco; Quebrada Martinez; 08.7942°N, 082.1905°W; 490 m a.s.l.; 24.v–6.vi.2018; T. Ríos, Y. Aguirre, leg.; Malaise trap; 1 male, MUPADI-SCH.2017.017 • ibid., 8–22.vi.2018; 1 male, MUPADI- SCH.20.018 • ibid., 5–19.vii.2018; 2 males, MUPADI-SCH.2017.019.

Distribution. Costa Rica, Panama.

Identification. This species was identified from its original description and figures (Bueno-Soria and Holzenthal 1998), as well as comparison with specimens of other species found within our extensive reference collection. *Ochrotrichia silva* is distinguished from other species in this genus by the short, strong hooklike process on the right side of the basal portion of tergum X, and by the long, spinelike process on the left side of tergum X which touches the apical process of that segment (Bueno-Soria and Holzenthal 1998).

Genus *Orthotrichia* Easton, 1873

Although worldwide in distribution, only three species of the genus *Orthotrichia* (Orthotrichiinae) are known from the Neotropics. They are found scattered in distribution from Mexico to Uruguay, and several islands in the Greater Antilles. Heretofore, none had been discovered in Panama. Herein we add this genus and one species to Panama's fauna.

Orthotrichia aegerfasciella (Chambers, 1873)

New records (3 localities). PANAMA – Panama Province • Cuenca 115; Panama Canal Zone; Gatun Lake; Abogado Island; 09.1992°N, 079.8600°W; 72 m a.s.l.; no date or collector given; 1 male, NMNH-SCH.2018.023 • ibid., Lion Hill Island; 09.2267°N, 079.8917°W; 66 m a.s.l.; no date or collector given; 1 male, NMNH-SCH.2018.024 • ibid., Tigre Island; 09.2311°N, 079.9108°W; 61 m a.s.l.; no date or collector given; 1 male, NMNH-SCH.2018.025 • ibid., Tigre Island; 28.viii.1981; R. Kinsey, leg.; UV light trap; 3 males, NMNH-SCH.2018.026.

Distribution. Canada, Cuba, Dominican Republic, Haiti, Mexico, Nicaragua, Panama, USA.

Identification. This species is the most widely occurring species of *Orthotrichia* in the New World. Specimens were compared to reference collection specimens, as well as with descriptions and figures by Ross (1944) and Harris and Rasmussen (2019). The males of this species are characterized by the laterally expanded arms of the subgential plate in ventral view, the lack of sclerotized bars or plates on tergum X, and the truncate posterolateral extension of segment IX (Harris and Rasmussen 2019).

Genus *Rhyacopsyche* Mueller, 1879

Rhyacopsyche (Ochrotrichiinae), a Neotropical endemic, is primarily South American in distribution with a few species extending to Central America and Mexico, and one species found on the Caribbean island of Tobago near the South American coast (Wasmund and Holzenthal 2007; Holzenthal and Calor 2017). Thirty species are known to occur in the Neotropics. Six of these are found in Panama, all of which have been recorded recently (Armitage and Harris 2018; Armitage et al. 2018; Thomson and Armitage 2018; and Harris and Armitage 2019). Herein we add two new country records to Panama's fauna.

Rhyacopsyche hasta Wasmund & Holzenthal, 2007

New records (1 locality). PANAMA – Panama Oeste Province • Cuenca 115; Altos de Campana National Park; Río Chileno, PSPSCB-PNAC-C115-2018-028; 08.7165°N, 080.0074°W; 497 m a.s.l.; 27.v.2018; E. Pérez, C. Nieto, M. Molinar, T. Ríos, leg.; UV light trap; 8 males, 4-COZEM-SCH.2018-057, 4-MUPADI-SCH.2018-027 • ibid., 23–31.v.2018; Malaise trap; 1 male, COZEM-SCH.2018.058.

Distribution. Panama, Peru.

Identification. This species was identified from the key, description, and figures in the revision of this genus (Wasmund and Holzenthal 2007). This species is easily recognized by the broad, spatulate inferior appendages which bear dark, peglike setae, and the structure of the phallus, which has the central tubule terminating in an elongate, basally directed filament. This elongate filament was only seen in a few of the specimens from Panama, and it could be easily broken off.

Rhyacopsyche mexicana (Flint, 1967)

New records (2 localities). PANAMA – Chiriqui Province • Cuenca 102; La Amistad International Park; Río Candela, Jurutungo; PSPSCD-PILA-C102-2017-020, 08.8997°N, 082.7379°W, 1728 m a.s.l., 19.vi.2017; E. Álvarez, E. Pérez, T. Ríos, leg.; UV light trap; 1 male; MUPADI-SCH.2018.101 • ibid., Río Candela–Finca Felix, PSPSCD-PILA-C102-2017-021; 08.9061°N, 082.7288°W; 1799 m a.s.l., 4.ix.2017, E. Álvarez, T. Ríos, E. Pérez, leg.; UV light trap; 3 males, COZEM-SCH-2018.102.

Distribution. Costa Rica, Guatemala, Mexico, Nicaragua, Panama.

Identification. This species was identified from the key, description, and figures in the revision of this genus

(Wasmund and Holzenthal 2007). Both this species and *R. obliqua* Flint, 1971, its closest congener, have a bifid apex of the inferior appendage, bearing one large peg-like seta. However, *R. mexicana* is distinguished by having inferior appendages with rounded dorsolateral lobes, whereas those of *R. obliqua* are truncated.

Genus *Zumatrichia* Mosely, 1937

A moderately large, Neotropical genus with approximately 52 species, *Zumatrichia* (Leucotrichiinae) is distributed from Mexico, through Central America, and into northern South America and the Caribbean islands. Panama is home to 19 species (Holzenthal and Calor 2017; Harris and Armitage 2019) and serves as the type country for 13 of those taxa. Herein we add one new country record.

***Zumatrichia strobilina* Flint, 1970**

New record (1 locality). PANAMA – Chiriqui Province • Cuenca 108; Baja Boquete; Valle Escondido; Quebrada Grande; 08.7797°N, 082.4402°W; 1122 m a.s.l.; 21.v.2018; UV light trap; B. Armitage, T. Arefina-Armitage, leg.; 1 male, MUPADI-SCH.2018.109.

Distribution. Costa Rica, Panama.

Identification. This species was identified employing keys, descriptions, and figures by Flint (1970), in addition to reference specimens on hand. It is most closely related to *Z. chiriquiensis* Flint, 1970 described from Panama. It differs from this species by the twisted, spiniferous basodorsal process of the inferior appendage, the narrow spines of the phallus, and the more narrow, lateral penal sheath.

Discussion

The discovery of *Orthotrichia aegerfasciella* in Panama was unexpected. Considering that all four records for this new genus and new species to Panama's fauna came from the Canal Zone, historically one of the most collected areas in Panama, this species should have been reported much earlier. Discovery of this species also identifies the southernmost extent of its distribution, which reaches northward into Canada. This is the eleventh genus that we have added to Panama's fauna since 2015.

Six of the species included herein help form additional distributional connections between Panama and northern South America (Colombia and Peru), which is not typical in the Hydroptilidae given their limited flight capabilities. The poorly collected Darien Province has been suggested as an apparent filter between Panama and Colombia to explain this. We hope to collect adult caddisflies in this province more rigorously to substantiate or refute this supposition.

This is the fifth paper devoted to new country records for Panama's trichopteran fauna since 2015 (Armitage et al. 2015, 2016, 2018, 2020). After six years of effort, there is no longer a surprise that this additive process continues. Given the steady accretion of species, and occasionally of families and genera, we cannot extrapolate with great confidence what Panama's final diversity total could be for this aquatic order. With the publication of this work, Panama now has 461 known species of Trichoptera. However, considering (1) that we already have in hand sufficient new, undescribed species to exceed 510 total species, (2) that almost each sample we take has one or more new taxa for Panama, (3) that the percent similarity of taxa between the fauna of Panama and its neighbors is very low, and (4) that vast portions of Panama have not been adequately sampled with multiple sampling methods for extended periods, it is not inconceivable that 700–750, or more, species will eventually be recorded from this incredibly diverse country.

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Authors' Contributions

Conceptualization: BA. Data curation: SH, BA. Formal analysis: SH. Funding acquisition: BA. Investigation: YA, TIAA, TARG. Project administration: BA. Resources: BA. Validation: TARG, YA. Writing – original draft: BA. Writing – review and editing: SH, TIAA.

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